Integrated Solar Energy Roofing Construction Panel

Annemarie H. Konold.

I claim:

1. An improved solar collector panel for thermal radiant cooling and for simultaneously converting solar energy to electrical power and thermal energy comprising: a rectangular frame with an open top side and a bottom side closed by an aluminum bottom plate; a photovoltaic grid for converting solar energy transmitted into the collector into electrical energy; a thermal collecting/radiator sheet, located on a plane below the photovoltaic grid, for converting solar energy transmitted into the collector into thermal energy; a copper tubing heat exchanger containing a plurality of interconnected heat collecting copper tubes disposed on a plane below the thermal collecting/radiator sheet but conductively coupled to the sheet through a thermally conductive material that collects thermal energy from the sheet and imparts that thermal energy in a fluid disposed within the heat collecting copper tubes; wherein the improvement comprises:

(a) a first waterproof, self-sealing, membrane with a top surface and an opposed bottom surface;
(b) a first adhesive layer in contact with the top surface of the first self-sealing, membrane forming an interface that is adhesively secured to the aluminum bottom plate of the collector by the first adhesive layer;
(c) mounting screw guide tubes that extend the entire depth of the collector panel from the top of the frame through the aluminum bottom plate evenly disposed around each side of the collector frame for securing the panel to the embedment with fasteners;
(d) a separate embedment component that includes:
    a. a bottom layer made from standard building construction material as used for roof or deck sheathing with a top surface and an opposed bottom surface;
    b. a second waterproof, self-sealing, membrane with a top surface and an opposed bottom surface;

c. a second adhesive layer in contact with the opposed bottom surface of the second waterproof, self-sealing, membrane that adhesively secures it to the building construction material top surface;

d. a solid insulation board with a top surface and an opposed bottom surface, whose thickness is selected to satisfy applicable local building codes when required, placed with opposed bottom surface in contact with the top surface of the second waterproof, self-sealing, membrane;

e. a second lap cement layer in contact with the exposed top surface of the solid insulation board;

f. a fiberglass and asphalt based sheathing with a top surface and an opposed bottom surface adhesively applied, opposed bottom surface down, to the second lap cement layer; and

g. a first lap cement layer in contact with the top surface of the fiberglass and asphalt based sheathing for receiving and adhesively securing the collector panel by its first waterproof, self-sealing, membrane opposed bottom surface and secondly secured with fasteners placed through the mounting screw guide tubes.

(e) copper quick connect fittings attached to the liquid inlet and outlet of each panel;

(f) copper pipe liquid connection manifolds for liquid distribution to and collection from panels arrays that are connected to the manifold by the copper quick connect fittings;

(g) a plastic raceway placed to receive electrical wiring from each panel or series panel string arranged in an array;

(h) quick-connect snap-in electrical connector plugs for the electrical interconnection of panels;

(i) quick-connect snap-in electrical connector receptacles to connect panels or series strings of panels to the raceway;

(j) a rain runoff collection trough connected to the lowest end of a slanted roof mounted solar panel or array of solar panels;

(k) solenoid valves and sprinkler head units connected between rows of panels that receive on/off control signals through their connected wiring; and

(l) an improved heat exchanger selected from the group consisting of: aluminum tubing heat exchanger; copper, thin-profile, water tank and aluminum, thin-profile, water tank.

2. The improved solar collector panel of claim 1 wherein the standard building construction material is exterior grade wood sheathing.

3. The improved solar collector panel of claim 1 wherein the fasteners are stainless steel screws.

4. The improved solar collector panel of claim 1 wherein the solenoid valve and sprinkler head units on/off control signal originates from a controller device whose input analog temperature signal originates from each solar panel internal temperature sensor.

5. An improved solar collector panel for thermal radiant cooling and for simultaneously converting solar energy to electrical power and thermal energy comprising: a rectangular frame with an open top side and a bottom side closed by an aluminum bottom plate; a photovoltaic grid for converting solar energy transmitted into the collector into electrical energy; a thermal collecting/radiator sheet, located on a plane below the photovoltaic grid, for converting solar energy transmitted into the collector into thermal energy; a copper tubing heat exchanger containing a plurality of interconnected heat collecting copper tubes disposed on a plane below the thermal collecting/radiator sheet but conductively coupled to the sheet through a thermally conductive material that collects thermal energy from the sheet and imparts that thermal energy in a fluid disposed within the heat collecting copper tubes; wherein the improvement comprises:

(a) a first waterproof, self-sealing, membrane with a top surface and an opposed bottom surface;

(b) a first adhesive layer in contact with the top surface of the first self-sealing, membrane forming an interface that is adhesively secured to the aluminum bottom plate of the collector by the first adhesive layer;

(c) mounting screw guide tubes that extend the entire depth of the collector panel from the top of the frame through the aluminum bottom plate evenly disposed around each side of the collector frame;

(d) a separate embedment component that includes:

a. a bottom layer made from standard building construction material as used for roof or deck sheathing with a top surface and an opposed bottom surface;

b. a second waterproof, self-sealing, membrane with a top surface and an opposed bottom surface;

c. a second adhesive layer in contact with the opposed bottom surface of the second waterproof, self-sealing, membrane that adhesively secures it to the building construction material top surface;

d. a second lap cement layer in contact with the exposed top surface of the second waterproof, self-sealing, membrane;

e. a fiberglass and asphalt based sheathing with a top surface and an opposed bottom surface adhesively applied, opposed bottom surface down, to the second lap cement layer; and

f. a first lap cement layer in contact with the top surface of the fiberglass and asphalt based sheathing for receiving and adhesively securing the collector panel by its first waterproof, self-sealing, membrane opposed bottom surface and secondly secured with fasteners placed through the mounting screw guide tubes.

(e) copper quick connect fittings attached to the liquid inlet and outlet of each panel;

(f) copper pipe liquid connection manifolds for liquid distribution to and collection from panels arrays that are connected to the manifold by the copper quick connect fittings;

(g) a plastic raceway placed to receive electrical wiring from each panel or series panel

string arranged in an array;

(h) quick-connect snap-in electrical connector plugs for the electrical interconnection of panels;

(i) quick-connect snap-in electrical connector receptacles to connect panels or series strings of panels to the raceway;

(j) a rain runoff collection trough connected to the lowest end of a slanted roof mounted solar panel or array of solar panels;

(k) solenoid valves and sprinkler head units connected between rows of panels that receive on/off control signals through their connected wiring; and

(l) an improved heat exchanger selected from the group consisting of: aluminum tubing heat exchanger; copper, thin-profile, water tank and aluminum, thin-profile, water tank.

6. The improved solar collector panel of claim 5 wherein the standard building construction material is exterior grade wood sheathing.

7. The improved solar collector panel of claim 5 wherein the fasteners are stainless steel screws.

8. The improved solar collector panel of claim 5 wherein the solenoid valve and sprinkler head units on/off control signal originates from a controller device whose input analog temperature signal originates from each solar panel internal temperature sensor.

9. An improved solar collector panel for thermal radiant cooling and for simultaneously converting solar energy to electrical power and thermal energy comprising: a rectangular frame with an open top side and a bottom side closed by an aluminum bottom plate; a thin-film photovoltaic grid vacuum deposited on a clear vinyl substrate for converting solar energy transmitted into the collector into electrical energy; a thermal collecting/radiator sheet, located on a plane below the thin-film photovoltaic grid, for converting solar energy transmitted into the collector into thermal energy; a copper

tubing heat exchanger containing a plurality of interconnected heat collecting copper tubes disposed on a plane below the thermal collecting/radiator sheet but conductively coupled to the sheet through a thermally conductive material that collects thermal energy from the sheet and imparts that thermal energy in a fluid disposed within the heat collecting copper tubes; wherein the improvement comprises:

(a) a first waterproof, self-sealing, membrane with a top surface and an opposed bottom surface;
(b) a first adhesive layer in contact with the top surface of the first self-sealing, membrane forming an interface that is adhesively secured to the aluminum bottom plate of the collector by the first adhesive layer;
(c) mounting screw guide tubes that extend the entire depth of the collector panel from the top of the frame through the aluminum bottom plate evenly disposed around each side of the collector frame;
(d) a separate embedment component that includes:
    a. a bottom layer made from standard building construction material as used for roof or deck sheathing with a top surface and an opposed bottom surface;
    b. a second waterproof, self-sealing, membrane with a top surface and an opposed bottom surface;
    c. a second adhesive layer in contact with the opposed bottom surface of the second waterproof, self-sealing, membrane that adhesively secures it to the building construction material top surface;
    d. a solid insulation board with a top surface and an opposed bottom surface, whose thickness is selected to satisfy applicable local building codes when required, placed with opposed bottom surface in contact with the top surface of the second waterproof, self-sealing, membrane;
    e. a second lap cement layer in contact with the exposed top surface of the solid insulation board;

f. a fiberglass and asphalt based sheathing with a top surface and an opposed bottom surface adhesively applied, opposed bottom surface down, to the second lap cement layer; and

g. a first lap cement layer in contact with the top surface of the fiberglass and asphalt based sheathing for receiving and adhesively securing the collector panel by its first waterproof, self-sealing, membrane opposed bottom surface and secondly secured with fasteners placed through the mounting screw guide tubes.

(e) copper quick connect fittings attached to the liquid inlet and outlet of each panel;

(f) copper pipe liquid connection manifolds for liquid distribution to and collection from panels arrays that are connected to the manifold by the copper quick connect fittings;

(g) a plastic raceway placed to receive electrical wiring from each panel or series panel string arranged in an array;

(h) quick-connect snap-in electrical connector plugs for the electrical interconnection of panels;

(i) quick-connect snap-in electrical connector receptacles to connect panels or series strings of panels to the raceway;

(j) a rain runoff collection trough connected to the lowest end of a slanted roof mounted solar panel or array of solar panels;

(k) solenoid valves and sprinkler head units connected between rows of panels that receive on/off control signals through their connected wiring; and

(l) an improved heat exchanger selected from the group consisting of: aluminum tubing heat exchanger; copper, thin-profile, water tank and aluminum, thin-profile, water tank.

10. The improved solar collector panel of claim 9 wherein the standard building construction material is exterior grade wood sheathing.

11. The improved solar collector panel of claim 9 wherein the fasteners are stainless steel screws.

12. The improved solar collector panel of claim 9 wherein the solenoid valve and sprinkler head units on/off control signal originates from a controller device whose input analog temperature signal originates from each solar panel internal temperature sensor.

13. An improved solar collector panel for thermal radiant cooling and for simultaneously converting solar energy to electrical power and thermal energy comprising: a rectangular frame with an open top side and a bottom side closed by an aluminum bottom plate; a thin-film photovoltaic grid vacuum deposited on a clear vinyl substrate for converting solar energy transmitted into the collector into electrical energy; a thermal collecting/radiator sheet, located on a plane below the photovoltaic grid, for converting solar energy transmitted into the collector into thermal energy; a copper tubing heat exchanger containing a plurality of interconnected heat collecting copper tubes disposed on a plane below the thermal collecting/radiator sheet but conductively coupled to the sheet through a thermally conductive material that collects thermal energy from the sheet and imparts that thermal energy in a fluid disposed within the heat collecting copper tubes; wherein the improvement comprises:

(a) a first waterproof, self-sealing, membrane with a top surface and an opposed bottom surface;
(b) a first adhesive layer in contact with the top surface of the first self-sealing, membrane forming an interface that is adhesively secured to the aluminum bottom plate of the collector by the first adhesive layer;
(c) mounting screw guide tubes that extend the entire depth of the collector panel from the top of the frame through the aluminum bottom plate evenly disposed around each side of the collector frame;
(d) a separate embedment component that includes:

a. a bottom layer made from standard building construction material as used for roof or deck sheathing with a top surface and an opposed bottom surface;
b. a second waterproof, self-sealing, membrane with a top surface and an opposed bottom surface;
c. a second adhesive layer in contact with the opposed bottom surface of the second waterproof, self-sealing, membrane that adhesively secures it to the building construction material top surface;
d. a second lap cement layer in contact with the exposed top surface of the second waterproof, self-sealing, membrane;
e. a fiberglass and asphalt based sheathing with a top surface and an opposed bottom surface adhesively applied, opposed bottom surface down, to the second lap cement layer; and
f. a first lap cement layer in contact with the top surface of the fiberglass and asphalt based sheathing for receiving and adhesively securing the collector panel by its first waterproof, self-sealing, membrane opposed bottom surface and secondly secured with fasteners placed through the mounting screw guide tubes.

(e) copper quick connect fittings attached to the liquid inlet and outlet of each panel;

(f) copper pipe liquid connection manifolds for liquid distribution to and collection from panels arrays that are connected to the manifold by the copper quick connect fittings;

(g) a plastic raceway placed to receive electrical wiring from each panel or series panel string arranged in an array;

(h) quick-connect snap-in electrical connector plugs for the electrical interconnection of panels;

(i) quick-connect snap-in electrical connector receptacles to connect panels or series strings of panels to the raceway;

(j) a rain runoff collection trough connected to the lowest end of a slanted roof

mounted solar panel or array of solar panels;

(k) solenoid valves and sprinkler head units connected between rows of panels that receive on/off control signals through their connected wiring; and

(l) an improved heat exchanger selected from the group consisting of: aluminum tubing heat exchanger; copper, thin-profile, water tank and aluminum, thin-profile, water tank.

14. The improved solar collector panel of claim 13 wherein the standard building construction material is exterior grade wood sheathing.

15. The improved solar collector panel of claim 13 wherein the fasteners are stainless steel screws.

16. The improved solar collector panel of claim 13 wherein the solenoid valve and sprinkler head units on/off control signal originates from a controller device whose input analog temperature signal originates from each solar panel internal temperature sensor.

17. An improved solar collector panel for thermal radiant cooling and for simultaneously converting solar energy to electrical power and thermal energy comprising: a rectangular frame with an open top side and a bottom side closed by an aluminum bottom plate; lens supports secured to the frame sides supporting Fresnel lenses that provide a passive solar tracking function; a photovoltaic grid for converting solar energy transmitted into the collector into electrical energy; a thermal collecting/radiator sheet, located on a plane below the photovoltaic grid, for converting solar energy transmitted into the collector into thermal energy; a copper tubing heat exchanger containing a plurality of interconnected heat collecting copper tubes disposed on a plane below the thermal collecting/radiator sheet but conductively coupled to the sheet through a thermally conductive material that collects thermal energy from the sheet and imparts that thermal energy in a fluid disposed within the heat collecting copper tubes; wherein the improvement comprises:

(a) a first waterproof, self-sealing, membrane with a top surface and an opposed bottom surface;

(b) a first adhesive layer in contact with the top surface of the first self-sealing, membrane forming an interface that is adhesively secured to the aluminum bottom plate of the collector by the first adhesive layer;

(c) mounting screw guide tubes that extend the entire depth of the collector panel from the top of the frame through the aluminum bottom plate evenly disposed around each side of the collector frame;

(d) a separate embedment component that includes:

a. a bottom layer made from standard building construction material as used for roof or deck sheathing with a top surface and an opposed bottom surface;

b. a second waterproof, self-sealing, membrane with a top surface and an opposed bottom surface;

c. a second adhesive layer in contact with the opposed bottom surface of the second waterproof, self-sealing, membrane that adhesively secures it to the building construction material top surface;

d. a solid insulation board with a top surface and an opposed bottom surface, whose thickness is selected to satisfy applicable local building codes when required, placed with opposed bottom surface in contact with the top surface of the second waterproof, self-sealing, membrane;

e. a second lap cement layer in contact with the exposed top surface of the solid insulation board;

f. a fiberglass and asphalt based sheathing with a top surface and an opposed bottom surface adhesively applied, opposed bottom surface down, to the second lap cement layer; and

g. a first lap cement layer in contact with the top surface of the fiberglass and asphalt based sheathing for receiving and adhesively securing the collector panel by its first waterproof, self-sealing, membrane opposed bottom

surface and secondly secured with fasteners placed through the mounting screw guide tubes.

(e) copper quick connect fittings attached to the liquid inlet and outlet of each panel;

(f) copper pipe liquid connection manifolds for liquid distribution to and collection from panels arrays that are connected to the manifold by the copper quick connect fittings;

(g) a plastic raceway placed to receive electrical wiring from each panel or series panel string arranged in an array;

(h) quick-connect snap-in electrical connector plugs for the electrical interconnection of panels;

(i) quick-connect snap-in electrical connector receptacles to connect panels or series strings of panels to the raceway;

(j) a rain runoff collection trough connected to the lowest end of a slanted roof mounted solar panel or array of solar panels;

(k) solenoid valves and sprinkler head units connected between rows of panels that receive on/off control signals through their connected wiring; and

(k) an improved heat exchanger selected from the group consisting of: aluminum tubing heat exchanger; copper, thin-profile, water tank and aluminum, thin-profile, water tank.

18. The improved solar collector panel of claim 17 wherein the standard building construction material is exterior grade wood sheathing.

19. The improved solar collector panel of claim 17wherein the fasteners are stainless steel screws.

20. The improved solar collector panel of claim 17 wherein the solenoid valve and sprinkler head units on/off control signal originates from a controller device whose input analog temperature signal originates from each solar panel internal temperature sensor.

21. An improved solar collector panel for thermal radiant cooling and for simultaneously converting solar energy to electrical power and thermal energy comprising: a rectangular frame with an open top side and a bottom side closed by an aluminum bottom plate; lens supports secured to the frame sides supporting Fresnel lenses that provide a passive solar tracking function; a photovoltaic grid for converting solar energy transmitted into the collector into electrical energy; a thermal collecting/radiator sheet, located on a plane below the photovoltaic grid, for converting solar energy transmitted into the collector into thermal energy; a copper tubing heat exchanger containing a plurality of interconnected heat collecting copper tubes disposed on a plane below the thermal collecting/radiator sheet but conductively coupled to the sheet through a thermally conductive material that collects thermal energy from the sheet and imparts that thermal energy in a fluid disposed within the heat collecting copper tubes; wherein the improvement comprises:

(a) a first waterproof, self-sealing, membrane with a top surface and an opposed bottom surface;
(b) a first adhesive layer in contact with the top surface of the first self-sealing, membrane forming an interface that is adhesively secured to the aluminum bottom plate of the collector by the first adhesive layer;
(c) mounting screw guide tubes that extend the entire depth of the collector panel from the top of the frame through the aluminum bottom plate evenly disposed around each side of the collector frame;
(d) a separate embedment component that includes:
    a. a bottom layer made from standard building construction material as used for roof or deck sheathing with a top surface and an opposed bottom surface;
    b. a second waterproof, self-sealing, membrane with a top surface and an opposed bottom surface;
    c. a second adhesive layer in contact with the opposed bottom surface of the second waterproof, self-sealing, membrane that adhesively secures it to the building construction material top surface;

d. a second lap cement layer in contact with the exposed top surface of the second waterproof, self-sealing, membrane;

e. a fiberglass and asphalt based sheathing with a top surface and an opposed bottom surface adhesively applied, opposed bottom surface down, to the second lap cement layer; and

f. a first lap cement layer in contact with the top surface of the fiberglass and asphalt based sheathing for receiving and adhesively securing the collector panel by its first waterproof, self-sealing, membrane opposed bottom surface and secondly secured with fasteners placed through the mounting screw guide tubes.

(e) copper quick connect fittings attached to the liquid inlet and outlet of each panel;

(f) copper pipe liquid connection manifolds for liquid distribution to and collection from panels arrays that are connected to the manifold by the copper quick connect fittings;

(g) a plastic raceway placed to receive electrical wiring from each panel or series panel string arranged in an array;

(h) quick-connect snap-in electrical connector plugs for the electrical interconnection of panels;

(i) quick-connect snap-in electrical connector receptacles to connect panels or series strings of panels to the raceway;

(j) a rain runoff collection trough connected to the lowest end of a slanted roof mounted solar panel or array of solar panels;

(k) solenoid valves and sprinkler head units connected between rows of panels that receive on/off control signals through their connected wiring; and

(l) an improved heat exchanger selected from the group consisting of: aluminum tubing heat exchanger; copper, thin-profile, water tank and aluminum, thin-profile, water tank.

22. The improved solar collector panel of claim 21 wherein the standard building construction material is exterior grade wood sheathing.

23. The improved solar collector panel of claim 21wherein the fasteners are stainless steel screws.

24. The improved solar collector panel of claim 21 wherein the solenoid valve and sprinkler head units on/off control signal originates from a controller device whose input analog temperature signal originates from each solar panel internal temperature sensor.

25. A method of installing improved solar collector panels with embedment, where local building codes require additional insulation, comprising the steps of:
assembling, at the factory, the collector panel;
assembling, at the factory, a first, waterproof, self-sealing membrane that includes a first adhesive layer in contact with the top surface of the first waterproof, self-sealing, membrane forming an interface;
adhesively securing, at the factory, the interface to the aluminum bottom plate of the solar collector by the first adhesive layer;
assembling, at the factory, a second, waterproof, self-sealing membrane that includes a second adhesive layer in contact with the opposed bottom surface of the second waterproof, self-sealing membrane;
adhesively securing, at the factory, the second waterproof, self-sealing membrane to the topside of roof or deck sheathing by the second adhesive layer forming the embedment;
installing the embedment to roofing joists by conventional construction fastening means;
placing a solid insulation board, opposed bottom surface down, on the embedment if required by local building codes;
applying a second layer of lap cement to the top surface of the solid insulation board;
covering the wet second layer of lap cement with a fiberglass and asphalt-based sheathing opposed bottom surface down;

applying a first layer of lap cement to the top surface of the fiberglass and asphalt-based sheathing;
placing the solar collector panel with the interface on the first layer of lap cement; and
securing the collector panel to the embedment with stainless steel screws, inserted through the mounting screw guide tubes, which are of selected length so that they penetrate only approximately half way through the roof or deck sheathing.

26. A method of installing improved solar collector panels with embedment, where additional insulation is not required, comprising the steps of:
assembling, at the factory, the collector panel;
assembling, at the factory, a first, waterproof, self-sealing membrane that includes a first adhesive layer in contact with the top surface of the first waterproof, self-sealing, membrane forming an interface;
adhesively securing, at the factory, the interface to the aluminum bottom plate of the solar collector by the first adhesive layer;
assembling, at the factory, a second, waterproof, self-sealing membrane that includes a second adhesive layer in contact with the opposed bottom surface of the second waterproof, self-sealing membrane;
adhesively securing, at the factory, the second waterproof, self-sealing membrane to the topside of roof or deck sheathing by the second adhesive layer forming the embedment;
installing the embedment to roofing joists by conventional construction fastening means;
applying a second layer of lap cement to the top surface of the second waterproof, self-sealing membrane;
covering the wet second layer of lap cement with a fiberglass and asphalt-based sheathing opposed bottom surface down;
applying a first layer of lap cement to the top surface of the fiberglass and asphalt-based sheathing;
placing the solar collector panel with the interface on the first layer of lap cement; and

securing the collector panel to the embedment with stainless steel screws, inserted through the mounting screw guide tubes, which are of selected length so that they penetrate only approximately half way through the roof or deck sheathing.